

NON-PUBLIC?: N

ACCESSION #: 9405180147

LICENSEE EVENT REPORT (LER)

FACILITY NAME: Arkansas Nuclear One, Unit One PAGE: 1 OF 6

DOCKET NUMBER: 05000313

TITLE: Reactor Trip on High Reactor Coolant System Pressure  
Resulting from a Lightning-Induced Closure of the Main  
Steam Isolation Valves

EVENT DATE: 04/11/94 LER #: 94-002-00 REPORT DATE: 05/10/94

OTHER FACILITIES INVOLVED: DOCKET NO: 05000

OPERATING MODE: N POWER LEVEL: 100

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10  
CFR SECTION:  
50.73(a)(2)(iv)

LICENSEE CONTACT FOR THIS LER:

NAME: Kimberly J. Miller, Nuclear Safety TELEPHONE: (501) 964-8605  
and Licensing Specialist

COMPONENT FAILURE DESCRIPTION:

CAUSE: C SYSTEM: JE COMPONENT: RJX MANUFACTURER: L045  
C IG FU E351

REPORTABLE NPRDS: Y  
N

SUPPLEMENTAL REPORT EXPECTED: NO

ABSTRACT:

On April 11, 1994, at approximately 2040, lightning struck in the vicinity of the ANO-1 Reactor Building causing a partial loss of power within channels "B" and "D" of the Emergency Feedwater Initiation and Control (EFIC) system. The power loss caused spurious trip of "A" train of EFIC which initiated actuation of the Emergency Feedwater (EFW) system and automatic closure of Main Steam Isolation Valves (MSIVs). The Reactor Protection System initiated a reactor trip due to high Reactor Coolant System pressure as a consequence of the closure of the MSIVs at power. During the post-trip response, a slight overcooling condition occurred. This resulted from the power loss to channel "B" EFIC which supplies the automatic control signal to train "A" EFW flow control valves and a "B" steam generator atmospheric dump control valve. This caused the "A" EFW flow control valves to remain fully open after the reactor trip, and the "B" ADV control valve to fully open upon loss of power, as designed. The operators terminated the overcooling event and returned the plant to normal post-trip parameters within eight minutes of the event. EFIC system power supplies were reset, other affected equipment was repaired, and various systems were demonstrated operable by surveillance. ANO-1 was returned to criticality at 0223 on April 15, 1994, and escalation to 100 percent power commenced.

END OF ABSTRACT

TEXT PAGE 2 OF 6

## A. Plant Status

At the time of this event, Arkansas Nuclear One, Unit One (ANO-1) was operating at 100 percent power. Reactor Coolant System (RCS) average temperature was approximately 579 degrees Fahrenheit and RCS pressure was 2155 psig. The ANO-1 area was experiencing inclement weather in the form of thunderstorm activity and had been under tornado warnings from 1904 until 2000 on the day of the event.

## B. Event Description

On April 11, 1994, at 2040:43, lightning struck in the vicinity of the ANO-1 Reactor Building. This resulted in spurious actuation of "A" train of Emergency Feedwater Initiation and Control (EFIC) with attendant Main Steam Line Isolation (MSLI) signal and subsequent Main Steam Isolation Valve (MSIV) closure. The reactor was automatically tripped by the Reactor Protection System (RPS) due to high RCS pressure resulting from closure of the MSIVs.

The lightning strike actuated the overvoltage protection feature of the 15 volt power supplies of channels "B" and "D" of the EFIC system causing a partial power loss to the affected channels. This partial loss of power resulted in a half-trip of EFIC train "B" and actuation of EFIC train "A". This initiated Emergency Feedwater (EFW) to both Once-Through Steam Generators (OTSGs), and automatic closure of the MSIVs for both OTSGs. Closure of the MSIVs caused RCS pressure to increase rapidly to the RPS high pressure trip setpoint (2355 psig). The Reactor Operator was in the process of manually tripping the reactor, as required by Emergency Operating Procedures, when an automatic trip of the reactor occurred eight seconds after the lightning strike. The lightning strike also caused blown

fuses in train "B" of the Inadequate Core Cooling Monitoring and Display System (ICCMDS)IG!. ICCMDS supplies RCS subcooling margin monitoring and reactor vessel water level indication.

During the post-trip response, multiple Main Steam Safety Valves (MSSVs) opened and re-closed automatically as needed to relieve pressure in the OTSGs. The "A" OTSG atmospheric dump valve (ADV) also opened to relieve initial high pressure in the "A" OTSG, and subsequently closed when pressure in the OTSG dropped below the programmed setpoint. The "B" OTSG ADV (CV-2618) opened due to the loss of power to channel "B" of EFIC. The "B" ADV block valve (CV-2619) remained closed because there was not a full trip of train "B" of EFIC. The ADV block valve was opened in manual from the control room to control high OTSG pressure and reduce the challenges to the MSSVs. The EFW flow control valves associated with the "A" EFW pump (CV-2645 and CV-2647) also receive their automatic control signal from EFIC train "B" and remained fully open due to the loss of power to that train. A slight overcooling condition resulted from a combination of the fully open EFW flow control valves, and the "B" ADV control valve being open due to loss of power to

TEXT PAGE 3 OF 6

channel "B" EFIC. This condition was recognized and corrected by the control room operators who throttled the "B" ADV block valve and closed CV-2645 and CV-2647  
o terminate the overcooling condition.

As a result of overcooling, RCS pressurizer level went off-scale low, and RCS pressure reached a minimum of approximately 1680 psig. High Pressure Injection (HPI)BQ! was initiated by the operators for approximately three

minutes to restore pressurizer level. At the time that HPI was secured, pressurizer level had been restored, and RCS pressure had returned to approximately 1800 psig. RCS temperature at this time was 522 degrees. RCS parameters were stabilized, and the unit was returned to normal post-trip conditions approximately eight minutes after the lightning strike occurred.

Power was restored to EFIC channels "B" and "D" at 2355 on April 11 by de-energizing the affected power supplies for approximately one minute and allowing the circuits to reset. Upon powering-up each channel, the indications for power supply voltage were within procedural specifications, and subsequent testing demonstrated that no other deficiencies existed. ICCMDS train "B" fuses (5 milli-Ampere) were replaced at 1736 on April 12, and after testing, ICCMDS was declared operable at 0048 on April 13. Both channels of EFIC were declared operable at 0452 on April 12. No Technical Specification allowable outage times were exceeded.

ANO-1 was returned to criticality at 0223 on April 15, 1994, and escalation to 100 percent power commenced with observers present in the control room to monitor the restart for any instrumentation abnormalities. No abnormalities attributable to the lightning strike were observed.

### C. Root Cause

The plant transient and subsequent reactor trip were initiated by an overvoltage condition on the 15 volt DC power supplies for channels "B" and "D" EFIC which actuated protective devices and resulted in the power supplies de-energizing. The partial loss of power to EFIC channels "B" and "D" resulted in the actuation of "A" train of EFW and MSIV closure. There were severe thunderstorms in the area at the time of the event, and several

eyewitnesses confirmed that there was a lightning strike in the vicinity of the ANO-1 Reactor Building at the approximate time of the reactor trip. The loss of the "B" and "D" EFIC 15 volt DC power supplies was due to the actuation of their protective devices which occurs at approximately 17 volts. Based on the observed equipment malfunctions, it is believed that the majority of the electrical interference associated with the lightning strike was induced into the electrical penetration rooms containing EFIC channel "B" and channel "D" field cabling. This interference is postulated to have entered the two EFIC channels via cable shielding which is tied to instrument signal common in each channel. This transient condition was sufficient to trip the power supply protective devices which monitor power supply voltage relative to signal common; however, the power supplies were not damaged. This is supported by the concurrent loss of "B" train of ICCMDS which has field circuits routed through the same penetration as channel "D" EFIC. No other phenomena were observed or revealed

TEXT PAGE 4 OF 6

through subsequent investigation which would account for these simultaneous effects. Therefore, it was concluded that the root cause of this event was the lightning strike.

#### D. Corrective Actions

The following corrective actions were performed prior to restart of the unit:

Power was restored to EFIC channel "B" and "D" by opening the breaker for each channel and allowing the protective devices to reset. After the circuit breakers were re-closed, the power supply voltages were verified to

be within procedural tolerances. Operability of "B" and "D" EFIC was verified by performing the applicable sections of their respective monthly surveillances. No discrepancies were noted.

The input fuses to ICCMDS train "B" were replaced, and a surveillance test was satisfactorily completed to prove operability. In addition, cross-checks were performed with related points of "A" train ICCMDS to verify data accuracy.

The monthly surveillance was performed on RPS channel "D" which shares the same reactor building penetration as channel "D" EFIC and train "B" ICCMDS. Engineered Safeguards Actuation System (ESAS)JE! channel 2 monthly surveillance was also completed because field circuits for this ESAS channel are routed through the lower north electrical penetration room where the aforementioned penetration is located. Other circuits sharing electrical penetrations with affected equipment were evaluated. These were either tested, verified by cross-channel checks, or determined not to be critical (e.g., two-way communications cable).

Operations personnel performed a thorough evaluation of plant instrumentation. This included operational log cross-channel checks, inspection of control room indications, panel wiring inspections, and a cable spreading room inspection.

Systems Engineering personnel performed walkdowns of physical structures in order to determine that there was no other damage resulting from the lightning strike. No indications of damage were found.

Training on the reactor trip event and the effects of the loss of EFIC power was conducted for all ANO-1 on-shift operators prior to their taking

the watch for plant start-up.

Additional personnel were assigned to monitor and trend control room indications for any abnormalities during plant start-up. No deficiencies attributable to the lightning strike were noted.

TEXT PAGE 5 OF 6

Future corrective actions planned include:

An evaluation of operating experience with lightning-induced transients at ANO and other nuclear facilities will be completed by October 15, 1994. Recommended actions, if any, will be included as part of the evaluation.

Simulator training will be developed on a reactor trip event involving a lightning strike scenario. This training will be presented to ANO-1 operators by August 8, 1994.

#### E. Safety Significance

The RPS initiated a reactor trip upon reaching the high RCS pressure setpoint as designed. The plant response to the transient was complicated by a slight overcooling condition resulting from specific component responses to a loss of power in EFIC channels "B" and "D". Operator intervention terminated the overcooling by controlling the affected valves manually from the control room handswitches. Reactor Operators also compensated for the RCS pressure decrease and loss of pressurizer level using the HPI system. ESAS operability was not affected by the lightning strike as demonstrated by later surveillances, and HPI would have been automatically initiated as required if the operators had not intervened.



The loss of "B" train of ICCMDS did not affect the ability of the operators to diagnose the condition of the plant because the redundant train was not affected.

Although this event was complicated by equipment malfunctions that resulted in a slight overcooling condition, the unit was returned to normal post-trip parameters approximately eight minutes after the lightning strike occurred. Therefore, this event is considered to be of low safety significance.

#### F. Basis for Reportability

This event is reportable pursuant to 10CFR50.73(a)(2)(iv) based on the automatic initiation of the RPS and the EFW system.

This event is also reportable pursuant to 10CFR50.72(b)(2)(ii) and (vi). The required information for these notifications was contained in the Notification of Unusual Events (NUE) which was conservatively declared at 2041 on April 11, 1994, based on the closure of the MSIVs at power. The NRC Operations Center was informed of the NUE at 2108 on April 11, 1994, and of NUE termination at 2255. The NUE was formally retracted at 1345 on April 12, 1994, after a review of the event determined that the entry conditions of the NUE (OTSG de-pressurization below 600 psig) had not been met.

TEXT PAGE 6 OF 6

#### G. Additional Information

There have been three previous occurrences of lightning-related reactor trips at ANO during the twenty years of operation at this site. The equipment affected by the lightning strike in this event was not similar to equipment affected in previous events. These events were reported in Licensee Event Reports 50-368/85-016-00, 50-313/86-004-00, and 50-313/87-002-00.

Energy Industry Identification System (EIIIS) codes are identified in the text by XX!.

ATTACHMENT TO 9405180147 PAGE 1 OF 2

Entergy  
Operations  
Entergy Operations, Inc.  
Route 3, Box 137G  
Russellville, AR 72801  
Tel 501-964-3100

May 10, 1994

1CAN059401

U. S. Nuclear Regulatory Commission  
Document Control Desk  
Mail Station P1-137  
Washington, DC 20555

Subject: Arkansas Nuclear One - Unit 1  
Docket No. 50-313

License No. DPR-51

Licensee Event Report 50-313/94-002-00

Gentlemen:

In accordance with 10CFR50.73(a)(2)(iv), enclosed is the subject report concerning the April 11, 1994, reactor trip.

Very truly yours,

Dwight C. Mims  
Director, Licensing

DCM/kjm

enclosure

ATTACHMENT TO 9405180147 PAGE 2 OF 2

U. S. NRC

May

0, 1994

1CAN059401 Page 2

cc: Regional Administrator

U. S. Nuclear Regulatory Commission

Region IV

611 Ryan Plaza Drive, Suite 400

Arlington, TX 76011-8064

Institute of Nuclear Power Operations  
700 Galleria Parkway  
Atlanta, GA 30339-5957

\*\*\* END OF DOCUMENT \*\*\*

---